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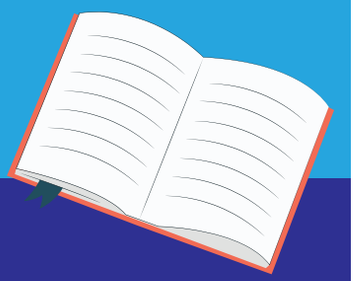
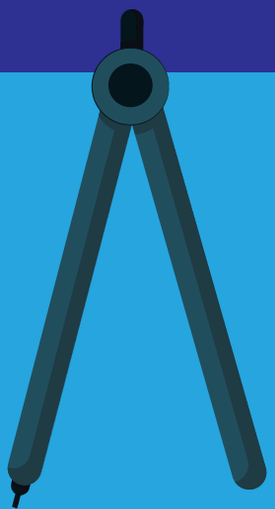


CLASS 12

BIOLOGY



CHAPTER WISE
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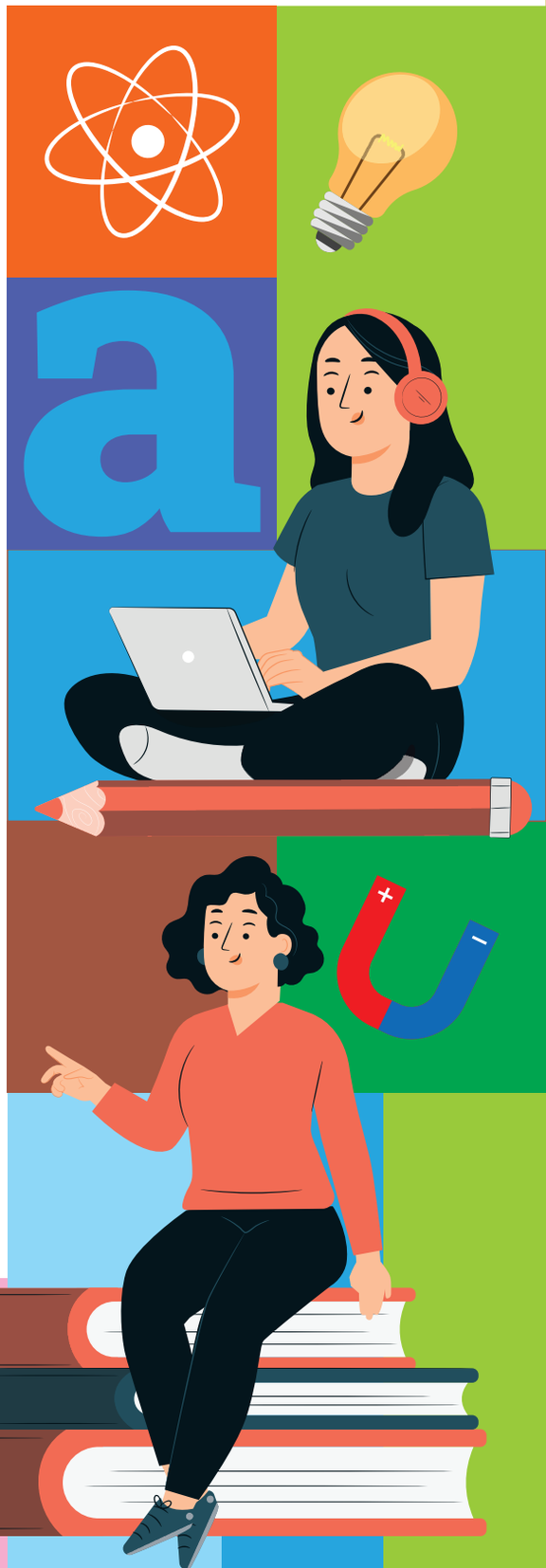
From 2014 to 2024



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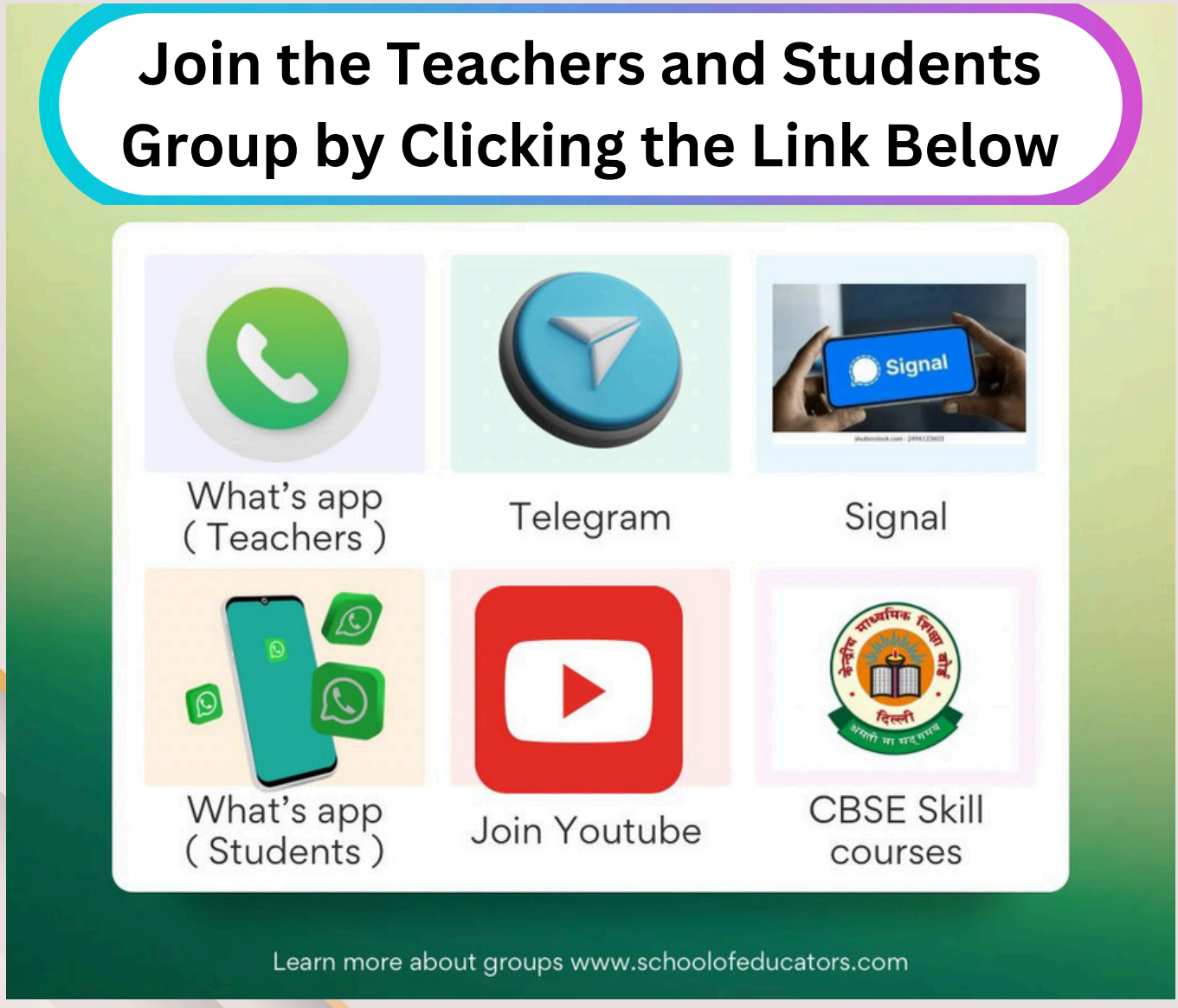


Class - 12 Biology

Previous Year Questions

Chapter - 2

Human Reproductions

Human Reproduction

The Male Reproductive System

SA I (2 marks)

1. Name and state the function of interstitial cell present in the human testes. (2021 C)

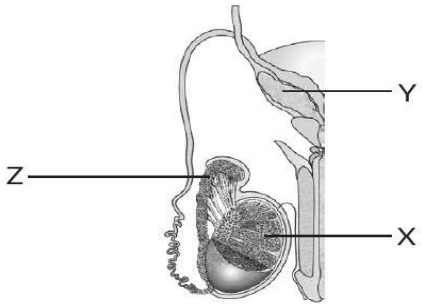
2. Why are the human testes located outside the abdominal cavity? Name the pouch in which they are present. (Al 2014)

3. Write the location and functions of the following in human testes:
(a) Sertoli cells
(b) Leydig's cells (Al 2014)

SA II (3 marks)

4. Draw a labelled diagram to show interrelationship of four accessory ducts in a human male reproductive system. (Delhi 2019)

5. The given diagram shows human male reproductive system (one side only).



(a) Identify ' X ' and write its location in the body.
(b) Name the accessory gland ' Y ' and its secretion.
(c) Name and state the function of ' Z '. (Delhi 2015C)

6. Draw a sectional view of seminiferous tubules of human. Label Sertoli cells, spermatogonia and Leydig's cell on it and write their function. (3/5, Al 2015C)

7. Read the following passage and answer the questions that follow.

Spermatogenesis is an important primary sex characteristic in humans and all other vertebrates. The process is coordinated and controlled under the influence of hormones. It starts with the onset of puberty in humans and thereafter continues. The primordial cells within the embryonic testis which differentiate into spermatogonia are the precursors of the sperms. These are located at the outer walls of the somniferous tubules where the process of spermatogenesis proceeds.

(a) State the site of action of FSH in the testes and describe its action there after.

OR

(a) Describe the role of LH in the process of spermatogenesis.

(b) Name the cells and their products which undergo:

(i) Mitosis and Differentiation

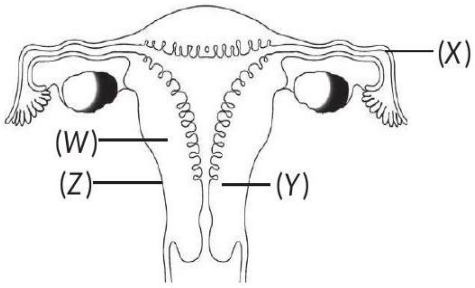
(ii) Meiosis I and Meiosis II during the process of spermatogenesis.

(c) Name the accessory ducts that the sperms travel through from somniferous tubules to reach the epididymis. (2024)

The Female Reproductive System

MCQ

8. The figure given below shows the sectional view of the human female reproductive system.

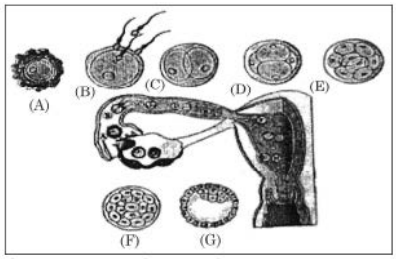


Identify the option that shows correct labeling for W, X, Y and Z in the given table.

	W	X	Y	Z
(a)	Endometrium	Infundibulum	Vagina	Perimetrium
(b)	Myometrium	Ampulla	Cervix	Perimetrium
(c)	Perimetrium	Ampulla	Vagina	Endometrium
(d)	Endometrium	Isthmus	Cervix	Myometrium

(Term I, 2021-22)

9. Select the option that gives the correct identification of ovum, morula and blastocyst in a human female reproduction system as shown in the following diagram



(a) Ovum – B, Morula – D, Blastocyst – F

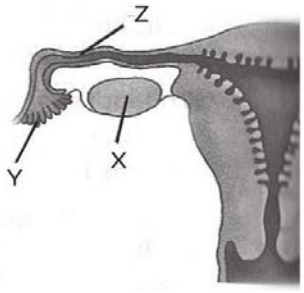
(b) Ovum – A, Morula – B, Blastocyst – G

(c) Ovum – A, Morula – E, Blastocyst – G

(d) Ovum – B, Morula – D, Blastocyst – G (2024)

SA II (3 marks)

10.



The diagram above shows a part of the human female reproductive system.
(a) Name the gamete cells that would be present in ' X ' if taken from a newborn baby.
(b) Name ' Y ' and write its function.
(c) Name ' Z ' and write the events that take place here. (Al 2015C)

11. Name and explain the role of the inner and middle walls of the human uterus. (Delhi 2014)

Gametogenesis

MCQ

12. In human sperm numerous mitochondria are present in the region known as
(a) Head
(b) Neck
(c) Middle piece
(d) Tail (Term I, 2021-22)

13. After spermatogenesis, the sperm heads get embedded in which of the following cells?
(a) Leydig cells
(b) Sertoli cells
(c) Germinal epithelium
(d) Seminal vesicle (2020)

14. The hormone that regulates the synthesis and secretion of androgens in human males is
(a) GH
(b) FSH
(c) LH
(d) prolactin. (2020 C)

15. In humans, the secondary oocyte completes meiotic division when:

(a) it gets implanted in the uterine endometrium.
(b) it is released from the matured Graafian follicle.
(c) it is penetrated by the sperm cell.
(d) acrosomal enzymes break down the zona pellucida. (2024)

SA I (2 marks)

16. Differentiate between spermiogenesis and spermiation. (2019C)

17. Explain the role of pituitary and sex hormones in the process of spermatogenesis. (2/5, Al 2015C)

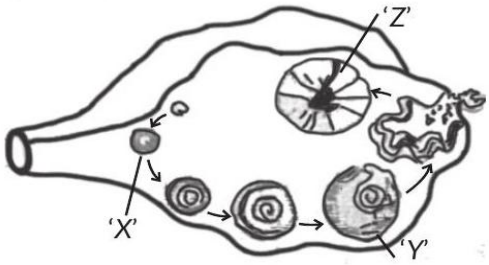
OR

Explain the hormonal regulation of the process of spermatogenesis in humans. (2/5, Al 2013)

18. Draw and label the parts of the head region only of a human sperm. (Al 2014C)

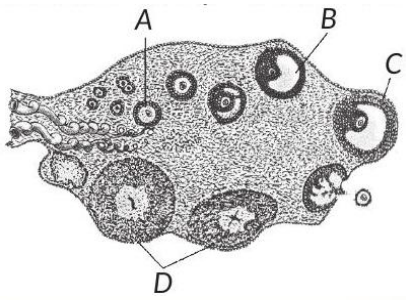
SA II (3 marks)

19. The diagram given below shows the events occurring in an ovary during oogenesis in a human female.



(a) Identify ' X ' Mention the time when the process occurs in a human female.
(b) Identify ' Y '. When and how is it formed?
(c) Name the hormone produced by 'Z' (2023)

20. Study the transverse section of human ovary given below and answer the questions that follow.



(a) Name the hormone that helps in growth of A→B→C.
(b) Name the hormone secreted by A and B.
(c) State the role of hormone produced by D. (2020)

21. Name the three different parts of a human sperm and write their involvement in the process of fertilisation. (2020 C)

22. Draw a sectional view of the human ovary showing the different stages of developing follicles, corpus luteum and ovulation. (Delhi 2019)

23. (a) Draw a sectional view of human ovary. Label the following parts:
(i) Primary follicle
(ii) Secondary oocyte
(iii) Graafian follicle
(iv) Corpus luteum
(b) Name the hormones influencing follicular development of corpus luteum. (Al 2019)

24. Construct a flow chart exhibiting sequential events of oogenesis. (2019 C)

25. Draw a diagram of a mature human sperm. Label any three parts and write their functions. (2018)

26. Draw a labelled diagrammatic sectional view of a human seminiferous tubule. (Delhi 2017, Foreign 2015, Delhi 2014)

27. Draw a labelled diagram of a human sperm. (NCERT, Foreign 2015)

28. Draw a diagram of human sperm. Label only those parts along with their functions that assist the sperm to reach and gain entry into the female gamete. (Foreign 2014)

29. Explain the hormonal control of spermatogenesis in humans. (Foreign 2014)

LA (5 marks)

30. (a) Draw a sectional view of a human ovary and label primary follicle, tertiary follicle, Graafian follicle and corpus luteum in it.
(b) Name the gonadotropins and explain their role in oogenesis and the release of ova. (2020)

31. (a) Draw a sectional view of a somniferous tubule of human. Label it's any six parts.

(b) Name the pituitary hormone involved in the process of spermatogenesis. State their function. (2020)

32. (a) Differentiate between spermatogenesis and oogenesis on the basis of:

(i) Time of initiation of the process
(ii) Site of completion of the process
(iii) Nature of meiotic division undergone by gamete mother cells
(b) Name the hormones and state their role involved in controlling spermatogenesis in humans. (2020)

33. Explain the development of a secondary oocyte (ovum) in a human female from the embryonic stage upto its ovulation. Name the hormones involved in this process. (Delhi 2015)

34. (a) Name the hormone that initiates spermatogenesis in humans. Describe the process of spermatogenesis in sequence mentioning the ploidy of the cells at each step.
(b) Draw the diagram of a mature human sperm and label the parts that
(i) helps it reaching to the ovum
(ii) providing energy for it to reach the ovum.
(iii) helping it to gain entry into the ovum. (Delhi 2015C)

35. Schematically represent and explain the events of spermatogenesis in humans. (NCERT, Delhi 2014C)

36. (a) Draw a labeled diagrammatic view of human male reproductive system.
(b) Differentiate between:
(i) Vas deferens and vasa efferentia.
(ii) Spermatogenesis and spermatogenesis. (Delhi 2014)

37. (a) How is 'oogenesis' markedly different from 'spermatogenesis' with respect to the growth till puberty in the humans?
(b) Draw a sectional view of human ovary and label the different follicular stages, ovum and corpus luteum. (NCERT Exemplar, Delhi 2014)

38. (a) Draw a transverse section of human ovary showing the sequential development of different follicles up to the corpus luteum.
(b) Comment on the corresponding ovarian and pituitary hormone levels during these events. (Al 2014C)

Menstrual Cycle

MCQ

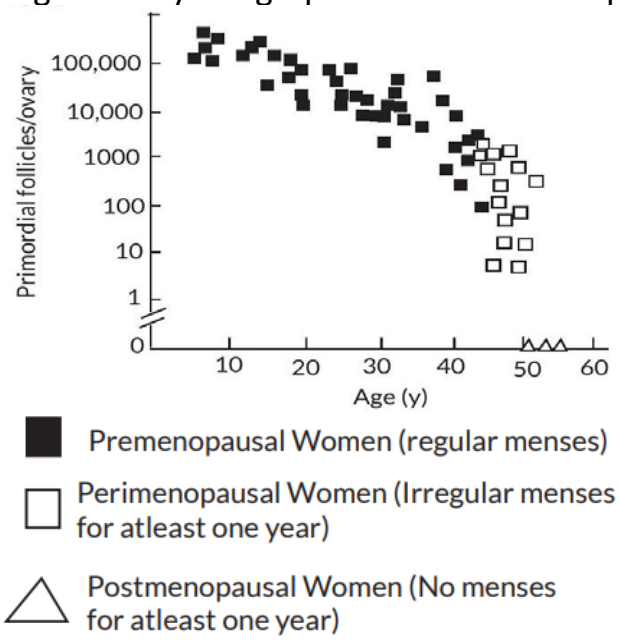
39. Which of the following hormones are active during the ovulatory phase of menstrual cycle in a normal human female?

(a) FSH and LH
(b) LH and Estrogen
(c) FSH and Estrogen
(d) Estrogen and Progesterone (2023)

40. The source organ and function of hormone FSH are
(a) Anterior pituitary, corpus luteum formation
(b) Posterior pituitary, Graafian follicle formation
(c) Anterior pituitary, follicular formation
(d) Hypothalamus, primary oocyte formation. (Term I, 2021-22)

SA I (2 marks)

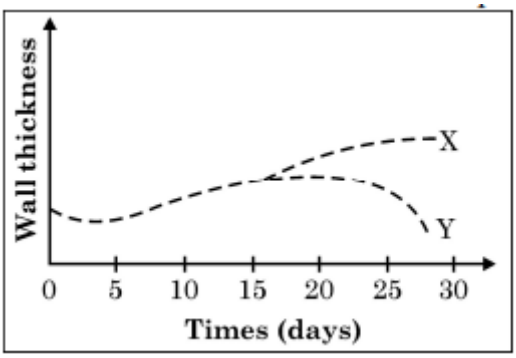
41. The graph given below shows the number of primordial follicles per ovary in women at different ages. Study the graph and answer the questions that follow:



(a) What is the average age of the women at the onset of menopause?
(b) At what age are maximum primordial follicles present in the ovary, according to the given graph? (2023)

42. Write the effect of the high concentration of LH on mature Graafian follicle. (Al 2014)

43. Study the graph given below that represents the changes in the thickening of the uterine wall in women 'X' and women 'Y' over a period of one month:



What does the graph with respect to woman 'X' and woman 'Y' indicate? Give a suitable reason. (2024)

SA II (3 marks)

44. Explain the uterine changes taking place during the follicular phase of the menstrual cycle in a human female. Name and explain the role of hormones that bring about these changes. (2021 C)

45. Explain the role of pituitary and ovarian hormones in the menstrual cycle of human females. (NCERT, 3/5, 2020)

46. Explain the events in a normal woman during her menstrual cycle on the following days:
(a) Ovarian event from 13-15 days
(b) Ovarian hormones level from 16 to 23 days
(c) Uterine events from 24 to 29 days (Delhi 2015C)

47. Explain the events in a normal woman during her menstrual cycle on the following days:
(a) Pituitary hormone levels from 8 to 12 days.
(b) Uterine events from 13 to 15 days.
(c) Ovarian events from 16 to 23 days. (Al 2015C)

LA (5 marks)

48. (a) Explain menstrual cycle in human females.
(b) How can the scientific understanding of the menstrual cycle of human females help as a contraceptive measure? (2018)

OR

(a) Explain the following phases in the menstrual cycle of a human female :

(i) Menstrual phase
(ii) Follicular phase
(iii) Luteal phase
(b) A proper understanding of menstrual cycle can help immensely in family planning. Do you agree with the statement? Provide reasons for your answer.
(Al 2017)

49. (a) Explain the menstrual phase in a human female. State the levels of ovarian and pituitary hormones during this phase.
(b) Why is follicular phase in the menstrual cycle also referred as proliferative phase? Explain.
(c) Explain the events that occur in a Graafian follicle at the time of ovulation and thereafter.
(d) Draw a Graafian follicle and label antrum and secondary oocyte. (Al 2016)

50. Describe the roles of pituitary and ovarian hormones during the menstrual cycle in a human female. (Al 2015)

OR

Explain the ovarian and uterine events that occur during a menstrual cycle in a human female under the influence of pituitary and ovarian hormones respectively.
(Delhi 2014)

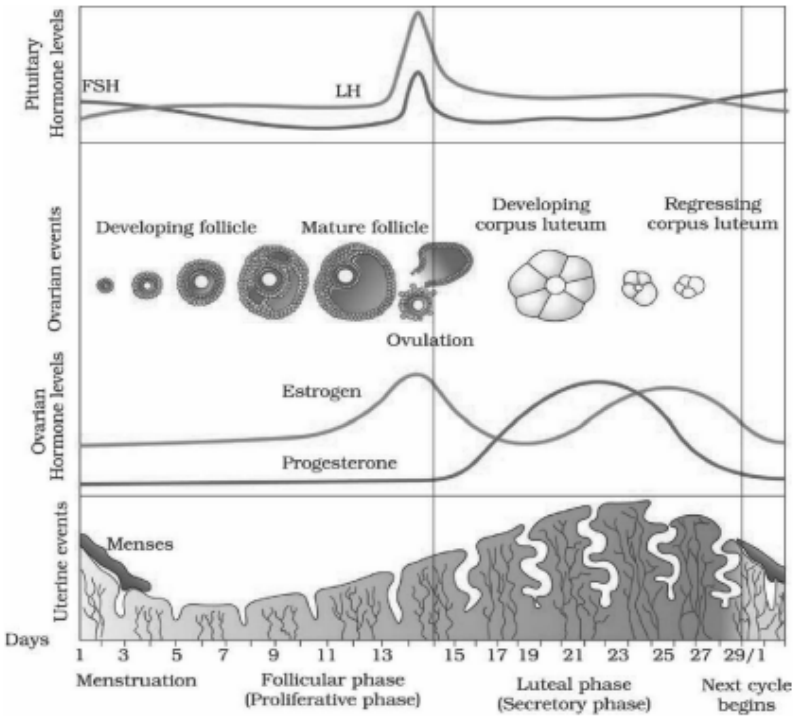
OR

Explain the different phases of menstrual cycle and correlate the phases with the different levels of ovarian hormones in a human female. (Al 2014C)

51. Explain the ovarian and uterine events taking place along with the role of pituitary and ovarian hormones, during menstrual cycle in a normal human female under the following phases :
(i) Follicular phase/proliferative phase
(ii) Luteal phase/secretory phase
(iii) Menstrual phase (2024)

CASE STUDY QUESTIONS:

52. In a human female, the reproductive phase starts on the onset of puberty and ceases around middle age of the female. Study the graph given below regarding menstrual cycle and answer the questions that follow:



(a) Name the hormones and their source organ, which are responsible for menstrual cycle at puberty. (b) For successful pregnancy, at what phase of the menstrual cycle an early embryo (upto 3 blastomeres) should be implanted in the Uterus (IUT) of a human female who has opted for Assisted Reproductive Technology (ART)? Support your answer with a reason.

(c) Name the hormone and its source organ responsible for the events occurring during proliferative phase of menstrual cycle. Explain the event.

OR

(c) In a normal human female, why does menstruation only occurs if the released ovum is not fertilized? Explain. (2024)

Fertilisation and Implantation

MCQ

53. The specific site for fertilisation in human female is

(a) infundibulum
(b) uterus
(c) ampulla
(d) ampullary isthmic junction. (2020 C)

VSA (1 mark)

54. Mention the function of zona pellucida. (1/2, Delhi 2015C)

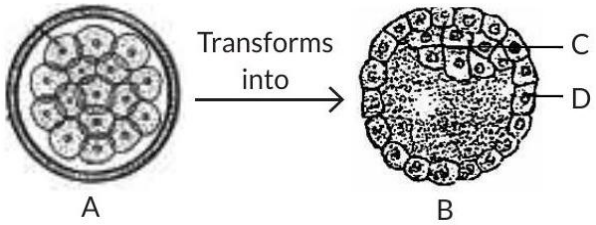
SA I (2 marks)

55. Where does fertilisation occur in humans? Explain the events that occur during this process. (2/5, AI 2014)

56. List the different parts of the human oviduct through which the ovum travels till it meets the sperm for fertilisation. (Delhi 2014C)

SA II (3 marks)

57. Study the given diagram.



A is an embryonic stage that gets transformed into B, which in turn gets implanted in the endometrium in human females.

(a) Identify A, B and its parts C and D.

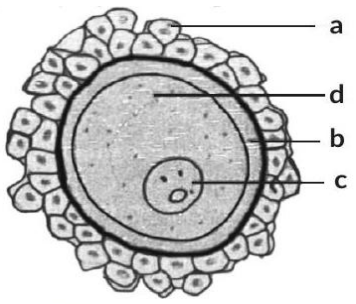
(b) State the fate of C and D in the course of embryonic development in humans. (2020)

58. Briefly explain the events of fertilisation and implantation in an adult human female. (3/5, Delhi 2016)

59. Name the stage of human embryo at which it gets implanted. Explain the process of implantation. (NCERT Exemplar, Delhi 2015)

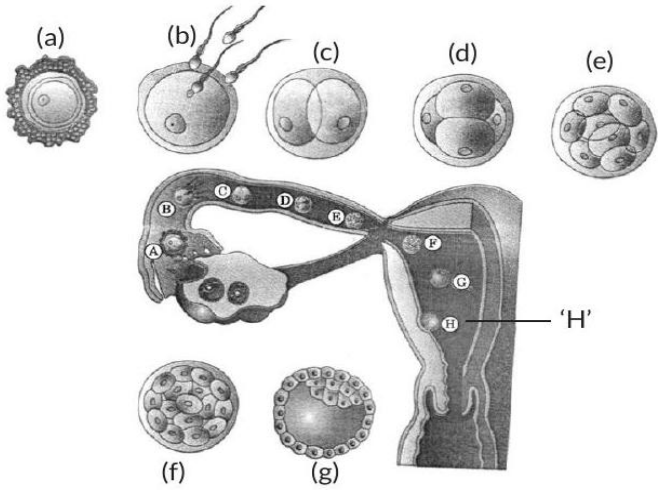
LA (5 marks)

60. Given below is a diagrammatic representation of a human ovum.



(i) Identify the parts 'a', 'b' and ' c '.
(ii) This ovum is released from the ovary with incomplete meiotic division. When, where and how is the meiotic division completed?
(iii) How does an ovum ensure the entry of a single sperm during fertilisation?
(2023)

61. Study the figure given below of a human female reproductive tract showing the transport of ovum, its fertilisation and growing embryo moving through the fallopian tube and answer the questions that follow:

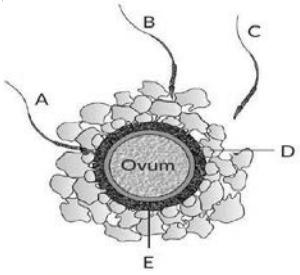


(i) Identify the embryonic stages ' e ' and ' g ' and differentiate between them.
(ii) Describe the process of implantation as shown in figure ' H '. (2021 C)

62. Where does fertilisation occur in the oviduct of human female? Describe the process of fertilisation. (2020)

63. (a) Explain the process of fertilisation in human.
(b) Name the embryonic stage that gets implanted in human females. Explain the process of implantation. (Delhi 2019)

64. Given below is the diagram of a human ovum surrounded by a few sperms. Study the diagram and answer the following questions:



(a) Which one of the sperms would reach the ovum earlier?
(b) Identify ' D ' and ' E '. Mention the role of ' E '.

(c) Mention what helps the entry of sperm into the ovum and write the changes occurring in the ovum during the process.
(d) Name the specific region in the female reproductive system where the event represented in the diagram takes place. (Al 2019)

65. Mention the site of fertilisation of a human ovum. List the events that follow in sequence until the implantation of the blastocyst. (Delhi 2015C, Foreign 2015)

Pregnancy and Embryonic Development

MCQ

66. During embryonic development the limbs and digits are formed in the human fetus by the end of
(a) 15 days of pregnancy
(b) 30 days of pregnancy
(c) 45 days of pregnancy
(d) 60 days of pregnancy. (Term I, 2021-22)

67. Which of the following are true in respect of chorionic villi in humans?
(i) It appears after implantation of hum\zan embryo in the uterus.
(ii) It becomes interdigitated with cervical tissue of the female reproductive tract.
(iii) It increases the surface area for exchange of materials.
(iv) It develops from the inner cell mass of the blastocyst.
Choose the correct option.
(a) (i) and (ii)
(b) (ii) and (iii)
(c) (i) and (iv)
(d) (i) and (iii) (Term I, 2021-22)

68. Which one of the following hormones is secreted by the human placenta that helps in the maintenance of pregnancy?
(a) Relaxin
(b) Human Chorionic Gonadotropin (hCG)
(c) Oxytocin
(d) Human Placental Lactogen (hPL) (2024)

SA I (2 marks)

69. List the three hormones produced in women only during pregnancy. What happens to the levels of estrogen and progesterone during pregnancy? (2020)

70. Comment on the role of placenta as an endocrine gland. (2/5, Delhi 2016)

SA II (3 marks)

71. Explain the formation of placenta after implantation in a human female. (2020)

72. (a) How is placenta formed in the human female?
(b) Name any two hormones which are secreted by it and are also present in a non-pregnant woman. (Foreign 2014)

73. (i) Explain the formation of placenta after the implantation in a human female.
(ii) Draw a diagram showing human fetus within the uterus and label any four parts in it. (2023)

74. (a) Arrange the following hormones in sequence of their secretion in a pregnant woman.
(b) Mention their source and the function they perform :
hCG; LH; FSH; Relaxin (Delhi 2017)

75. (a) When and how does placenta develop in human female?
(b) How is the placenta connected to the embryo?
(c) Placenta acts as an endocrine gland. Explain. (Delhi 2015)

Parturition and Lactation

MCQ

76. Assertion (A): The perimetrium of uterus exhibits strong uterine contractions during child birth.
Reason (R): Oxytocin released from maternal pituitary causes strong uterine contractions.
(a) Both Assertion (A) and Reason (R) are correct statements, and Reason (R) is the correct explanation of the Assertion (A).
(b) Both Assertion (A) and Reason (R) are correct statements, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is correct, but Reason (R) is incorrect statement.
(d) Assertion (A) is incorrect, but Reason (R) is correct statement. (Term I, 2021-22)

VSA (1 mark)

77. State from where the signals for parturition originate in human females.
(NCERT Exemplar, Al 2019)

SA II (3 marks)

78. Medically it is advised to all young mothers that breast feeding is the best for their newborn babies. Do you agree? Give reasons in support of your answer. (2018)

79. Why is breast feeding recommended during the initial period of an infant's growth? Give reason. (Delhi 2016)

80. Describe the process of parturition in humans. (Delhi 2015)

Assisted Reproductive Technologies:

81. Explain the IUI and IVF methods of assisted reproductive technologies. (2024)

Class - 12 Biology

PYQ Solutions

Chapter 2

Human Reproduction

SOLUTIONS

1. (b): Interstitial cells synthesise and secrete testicular hormones called androgens (e.g., testosterone).

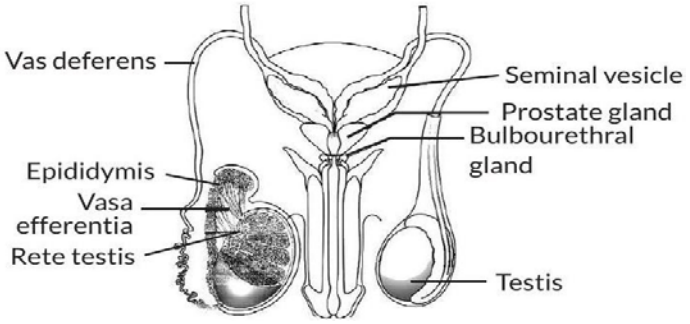
2. The human testes are located outside the abdominal cavity within a pouch called scrotum. The scrotum helps in maintaining the low temperature of the testes $(2-2.5^{\circ}\mathrm{C})$ lower than the normal internal body temperature, necessary for spermatogenesis.

Note:

- Scrotum protects the testicles and acts as a temperature control system.

3. (a) Sertoli cells are present in the wall of seminiferous tubules. Sertoli cells provide nourishment to the developing sperms.
   (b) Leydig's cells present between the seminiferous tubules, synthesise and secrete testicular hormones called androgens.

4. The interrelationship of four male sex accessory ducts; rete testis, vasa efferentia, vasa deferentia and epididymis shown in the given diagram.

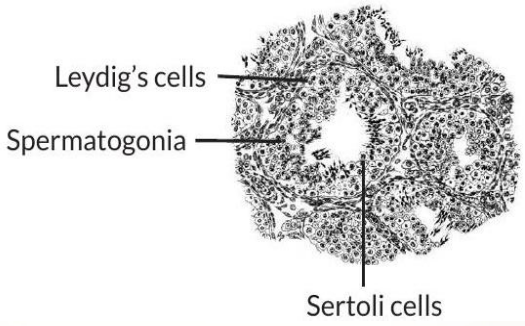


5. (a) X is testis. It is located outside the abdominal cavity within a pouch called scrotum.
   (b) Y is seminal vesicle. It produces an alkaline secretion which forms 60% of the volume of the semen.
   (c) Z is epididymis. It stores the sperms and also secretes a fluid which nourishes the sperms.

Note:

- Seminal vesicle - Male accessory gland
- Epididymis - Male sex accessory duct

6. Sectional view of human seminiferous tubule is as follows:



Functions:
(i) Sertoli cells: These cells provide nourishment to the developing sperms.
(ii) Spermatogonia: During spermatogenesis, spermatogonia grow into primary spermatocytes which undergo meiosis, producing haploid cells, first secondary spermatocytes and then spermatids. The spermatids then convert into spermatozoa (sperms).
(iii) Leydig's cell: Leydig's cells present between the seminiferous tubules, synthesise and secrete testicular hormones called androgens.

7. FSH acts on the Sertoli cells in the seminiferous tubules of the testes. It stimulates the Sertoli cells to facilitate the process of spermatogenesis by providing nourishment and support to the developing spermatogenic cells.
OR
LH stimulates the Leydig cells in the testes to produce testosterone. Testosterone is crucial for the development and maintenance of male reproductive tissues and for the continuation of spermatogenesis.
(b) Name the cells and their products which undergo:
(i) Mitosis and Differentiation:
Spermatogonia undergo mitosis and differentiation to produce primary spermatocytes.
(ii) Meiosis I and Meiosis II during the process of spermatogenesis:
Primary spermatocytes undergo Meiosis I to produce secondary spermatocytes, which then undergo Meiosis II to produce spermatids.
(c) Name the accessory ducts that the sperms travel through from seminiferous tubules to reach the epididymis.
The sperms travel through the rete testis and efferent ductules to reach the epididymis.

8. (b) : W-Myometrium, X-Ampulla, Y-Cervix,
Z – Perimetrium

9. (c) Ovum -A, Morula - E, Blastocyst – G (2024)

10. (a) Primary oocytes will be present in ovary (X) of a newborn baby.
(b) Y is fimbriae. The edges of the infundibulum possess finger-like projections called fimbriae, which help in collection of the ovum after ovulation.
(c) Z is the ampullary-isthmic junction. It is the site of fertilisation in humans.

11. The inner glandular wall of the uterus is known as endometrium.
Role - During the menstrual cycle, the endometrium wall grows into a thick, vascular (blood vessel-rich) glandular layer. This condition of the endometrium favours the implantation of the fetus. If fertilisation does not occur, the endometrium is

shed during the hemorrhagic phase of the menstrual cycle.
The middle wall of the uterus is known as myometrium. Role-It consists of smooth muscles. It exhibits contraction during delivery of the baby.

12. (c): The middle piece of sperm contains mitochondria coiled around the axial filament. They provide energy for the movement of the sperm.

Note:
Middle piece is the power house of sperm.

13. (b)

14. (c)

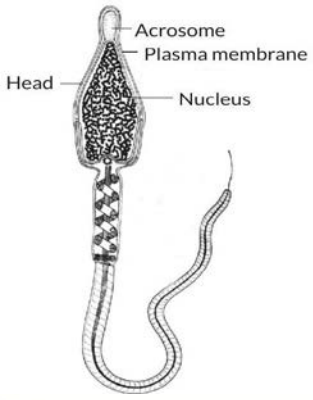
15. (C) it is penetrated by the sperm cell. (2024)

16. Differences between spermiogenesis and spermiation are as follows:

Spermiogenesis	**Spermiation**
It is the process of transforming spermatids into matured spermatozoa or sperms.	It is the process by which mature spermatozoa or spermatids are released from the Sertoli cells into the seminiferous tubule lumen prior to their passage to the epididymis.

17. During spermatogenesis, gonadotropin releasing hormone (GnRH) is secreted by the hypothalamus, which stimulates the anterior pituitary gland to secrete luteinising hormone (LH) and follicle stimulating hormone (FSH). LH acts on the Leydig's cells of the testes to secrete testosterone while FSH acts on Sertoli cells of the seminiferous tubules of the testes to secrete androgen binding protein (ABP) and inhibin. ABP concentrates testosterone and inhibin suppresses FSH synthesis. FSH also acts on spermatogonia to stimulate sperm production.

18. Labelled parts of head region of human sperm are as follows



19. (a) In the given figure, X is primary follicle. The process is initiated during embryonic development stage.

(b) Y is Graafian follicle. Graafian follicle is formed during ovulation stage. The primary follicles are surrounded by more layers of granulosa cells and called secondary follicles. The secondary follicle soon changes into a tertiary follicle which is characterised by a fluid filled cavity called follicular antrum. The tertiary follicle is further converted into mature follicle or Graafian follicle.

(c) Z is corpus luteum which secretes progesterone hormone.

20. (a) In the given figure A is primary follicle, B is tertiary follicle showing antrum and C is Graafian follicle. Anterior lobe of pituitary gland secrete LH and FSH. FSH stimulates the growth of ovarian follicles, i.e., from $\mathrm{A} \rightarrow \mathrm{B} \rightarrow \mathrm{C}$.

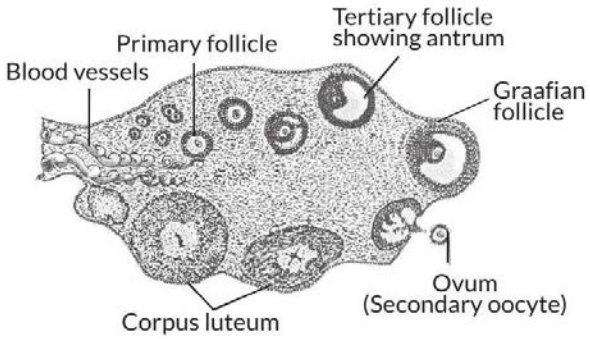
(b) Hormone secreted by A and B is estrogen.

(c) D in the given figure is corpus luteum. It secretes progesterone which helps in the maintenance of endometrium.

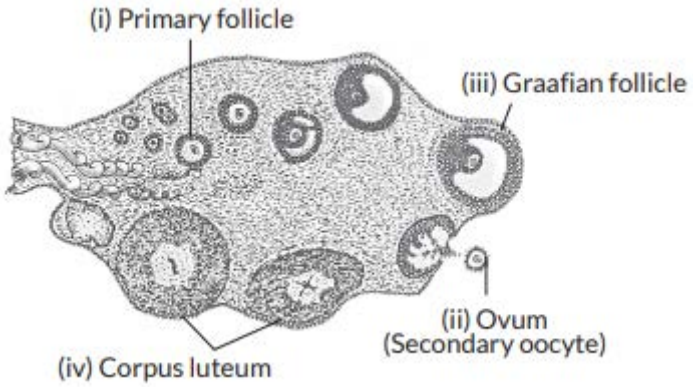
21. The three different parts (regions) of the human sperm are head, middle piece and the tail. Their involvement in the process of fertilisation are as follows:

Head - contains nucleus and enzyme in acrosome. During fertilisation, acrosome helps the sperm to enter the egg and the nucleus of sperm combines with the nucleus of the egg and restores the normal number of 23 pairs of chromosomes. Middle piece: It contains mitochondria which acts as a power house of the sperm cell and there are several mitochondria available at the middle piece. This gives the ability to navigate in the female gene (reproductive) tract. Tail - It help the sperm to reach to the egg.

22. Diagrammatic sectional view of human ovary showing the development of follicles, corpus luteum and ovulation is as follows:



23.(a) Diagrammatic sectional view of human ovary is as follows:

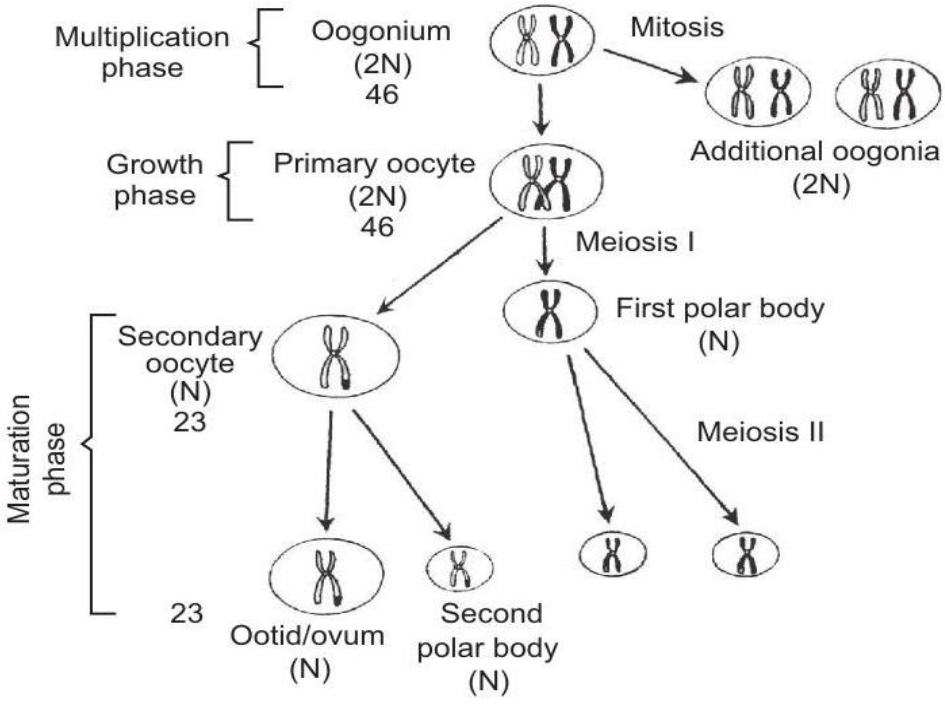


(iv) Corpus luteum (b) After ovulation, the remaining cells of the ovarian follicles are stimulated by luteinising hormone (LH) to develop corpus luteum. Now, the corpus luteum secretes large amount of progesterone that is essential for the maintenance of the endometrium.

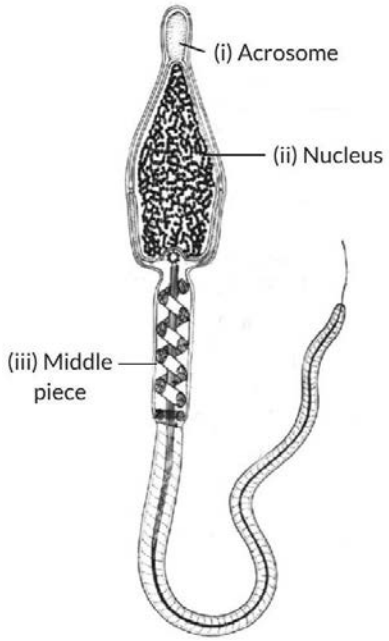
Note:

- LH is secreted by anterior pituitary gland which is stimulated by GnRH secreted by hypothalamus.
-

24. Flowchart showing the schematic representation of events of oogenesis is as follows:



25. The diagram of a human sperm with labelled partsacrosome, nucleus and middle piece is as follows:

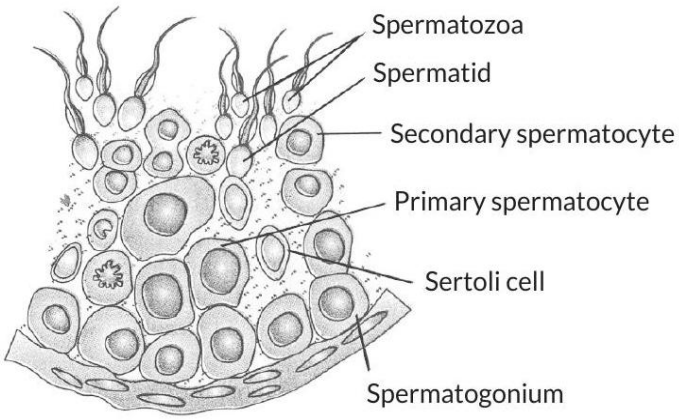


Three important parts of mature human sperm and its functions are as follows:
(i) Acrosome: It is formed from Golgi body and contains enzymes called sperm lysins that are used to contact and penetrate the egg at the time of fertilisation.
(ii) Nucleus : It contains chromosomal material which is the carrier of genetic information.
(iii) Middle piece: It contains mitochondria in spiral form that provides energy for the movement of the sperm hence also called power house of sperm.

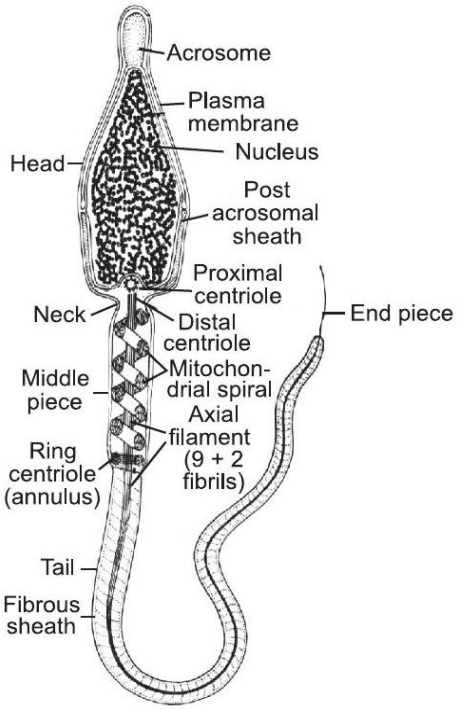
Note:

- Head of sperm contains anterior small acrosome and posterior large nucleus.

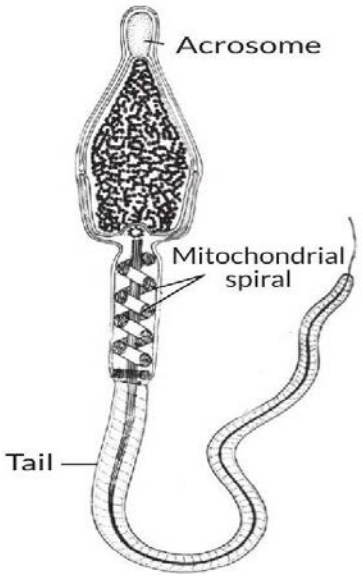
26. Sectional view of human seminiferous tubule is as follows:



27. Labelled diagram of a human sperm is as follows:



28. Diagram of a human sperm with labelled parts that assist in sperm to reach and gain entry into female gametes is as follows :



Functions:

Acrosome - It contains enzymes called spermlysins that are used to contact and penetrate the egg at the time of fertilisation.

Mitochondrial spiral - It provides energy for the movement of the sperm.

Tail - It help the sperm to reach to the egg.

Note:

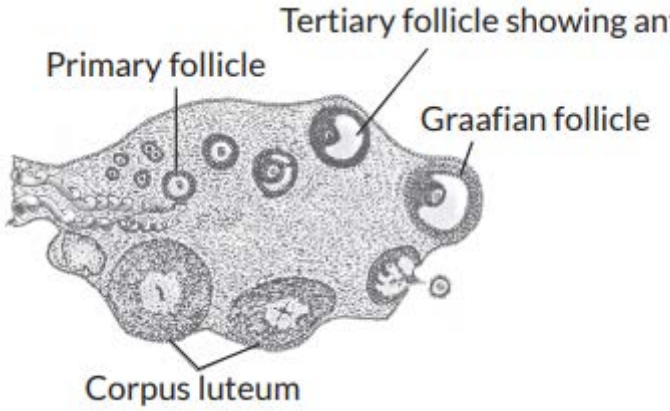
- On an average sperm production takes around 64 days. After coitus, sperm cells can live upto as long as 5 days in female reproductive system.

29. During spermatogenesis, gonadotropin releasing hormone (GnRH) is secreted by the hypothalamus, which stimulates the anterior pituitary gland to secrete luteinising hormone (LH) and follicle stimulating hormone (FSH). LH acts on the Leydig's cells of the testes to secrete testosterone while FSH acts on Sertoli cells of the seminiferous tubules of the testes to secrete androgen binding protein (ABP) and inhibin. ABP concentrates testosterone and inhibin suppresses FSH synthesis. FSH also acts on spermatogonia to stimulate sperm production.

Note:

In males, LH is called interstitial cells stimulating hormone (ICSH).

30. (a) Diagrammatic sectional view of human ovary showing the sequential development of different follicles, upto corpus luteum is as follows:



(b) GnRH secreted by the hypothalamus stimulates the anterior lobe of pituitary gland to secrete LH and FSH. FSH stimulates the growth of Graafian follicles and also the development of egg/oocyte within the follicle to complete the meiosis I to form secondary oocyte. FSH also stimulates the formation of estrogens. LH induces the rupture of the mature Graafian follicle and thereby the release of secondary oocyte. Thus LH causes ovulation. The remaining part of the Graafian follicle is stimulated by LH to develop into corpus luteum which secretes progesterone.

The rising level of progesterone inhibits the release of GnRH, which in turn, inhibits production of FSH, LH and progesterone.

31. (a) (**a) Sectional View of a Seminiferous Tubule of Human with Labels**

Here's a simple diagram of a sectional view of a seminiferous tubule of a human:

Labeled Parts:

1. **Spermatogonia**: Located on the basal lamina, these are the germ cells that divide by mitosis.
2. **Primary Spermatocytes**: These cells undergo the first meiotic division to form secondary spermatocytes.

3. **Secondary Spermatocytes**: These cells undergo the second meiotic division to form spermatids.
4. **Spermatids**: These immature sperm cells undergo spermiogenesis to become mature spermatozoa.
5. **Spermatozoa**: The mature sperm cells released into the lumen.
6. **Sertoli Cells**: These cells support and nourish the developing sperm cells.
7. **Lumen**: The central cavity where mature sperm are released.

(b) Pituitary Hormone Involved in Spermatogenesis and Its Function

Hormones:

1. **Follicle Stimulating Hormone (FSH)**
2. **Luteinizing Hormone (LH)**

Functions:

- **FSH**: Stimulates the Sertoli cells, which are essential for nurturing the developing sperm cells and facilitating the process of spermatogenesis.
- **LH**: Stimulates the Leydig cells, which are located outside the seminiferous tubules, to produce testosterone. Testosterone is crucial for the development of secondary sexual characteristics and the promotion of spermatogenesis.

(b) Pituitary gland secretes two hormones, FSH and LH. LH acts on Leydig's cells of the testes to secrete testosterone. FSH acts on Sertoli cells of the seminiferous tubules of the testes to secrete Androgen Binding Protein (ABP) which concentrates testosterone in seminiferous tubules. FSH acts on spermogonia to stimulate sperm production.

32. (a) Differences between spermatogenesis and oogenesis are as follows:

	Spermatogenesis	Oogenesis
(i) Time of initiation of the process	It starts in males at the age of puberty.	It is initiated in females during the embryonic development stage when a couple of oogonia are formed within each fetal ovary.
(ii) Site of completion of the process	It is completed in the testes and mature sperms are released from the seminiferous tubules.	It is completed in the female reproductive tract, in the ovary. The Graffian follicle ruptures to release the ovum from the ovary (ovulation).

(iii) Nature of meiotic division undergone by gamete cells	It involves equal cytoplasmic division.	It involves unequal cytoplasmic divisions.

33. The process of formation of a mature female gamete (ovum) is called oogenesis. It occurs in the ovaries. It consists of three phases : multiplication, growth and maturation.

(i) Multiplication phase: In the fetal development, certain cells in the germinal epithelium of the ovary of the fetus are larger than others. These cells divide by mitosis, producing a couple of million egg mother cells or oogonia in each ovary of the fetus. The oogonia multiply by mitotic divisions forming the primary oocytes.

(ii) Growth phase: This phase of the primary oocyte is very long. The oogonium grows into a large primary oocyte by taking food from the surrounding follicle cells.

(iii) Maturation phase: Each primary oocyte undergoes two maturation divisions, first meiotic and the second meiotic.

In the first, meiotic division, the primary oocyte divides into two very unequal haploid daughter cells - a large secondary oocyte and a very small first polar body or polocyte. In the second maturation division, the first polar body may divide to form two second polar bodies. The secondary oocyte again divides into unequal daughter cells, a large ootid and a very small second polar body. The ootid grows into a functional haploid ovum. Thus, from one oogonium, one ovum and three polar bodies are formed. The polar bodies take no part in reproduction and, hence, soon degenerate. In humans, ovum is released from the ovary in the secondary oocyte stage, this process is called ovulation.

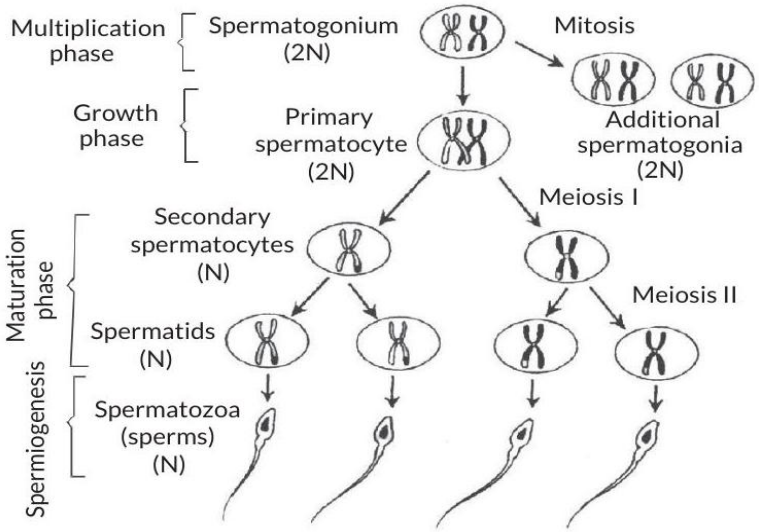
The hormones involved in this process are luteinising hormone (LH) and follicle stimulating hormone (FSH), both secreted by anterior pituitary gland under the influence of GnRH from hypothalamus. FSH stimulates the growth of Graafian follicle and also the development of egg (secondary oocyte) within the follicle. LH induces the rupture of mature Graafian follicle and thereby the release of secondary oocyte (ovulation).

Note:

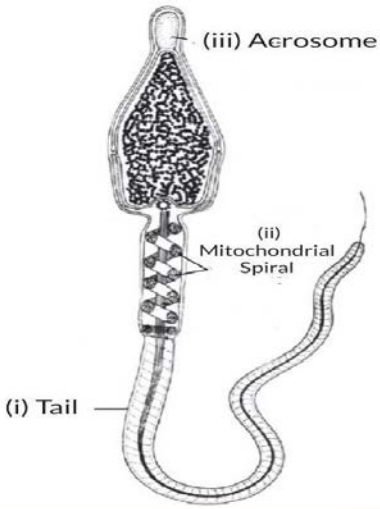
- Maturation of secondary oocyte is completed in the fallopian tube usually after the sperm has entered the secondary oocyte for fertilisation.

34. (a) In humans, follicle stimulating hormone (FSH) initiates the process of spermatogenesis.

Spermatogenesis is the process of formation of haploid spermatozoa from diploid spermatogonia inside the testes of the male. It includes following three phases:
(i) Multiplication phase - At sexual maturity, the undifferentiated primordial germ cells divide several times by mitosis to produce a large number of spermatogonia or sperm mother cells. Spermatogonia (2N) are of two types: type A spermatogonia and type B spermatogonia. Type A spermatogonia serve as the stem cells which divide to form second type of spermatogonia whenever required.
Type B spermatogonia are progenitor cells which function as precursors of spermatozoa.
(ii) Growth phase-Each type Bspermatogonium actively grows to a larger primary spermatocyte by obtaining nourishment from the nursing cells.
(iii) Maturation phase - Each primary spermatocyte undergoes two successive divisions, called maturation divisions. The first maturation division is reductional or meiotic. Hence, the primary spermatocyte divides into two haploid daughter cells called secondary spermatocytes. Both secondary spermatocytes now undergo second maturation division which is an ordinary mitotic division to form four haploid spermatids, by each primary spermatocyte.

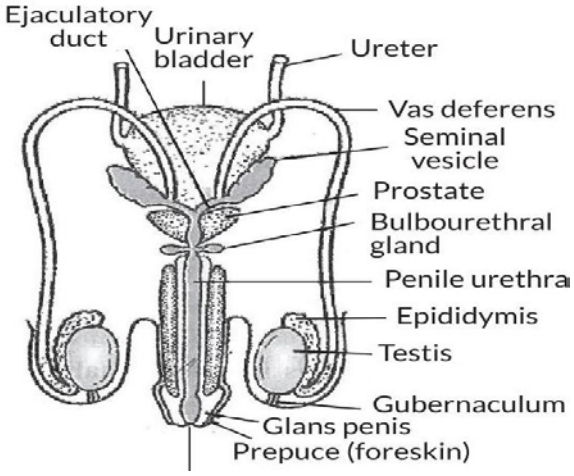


(b) The labelled diagram of human sperm is as follows:



35. Refer to answer 31 (a).

36. (a) Diagrammatic view of human male reproductive system is as follows:



External urethral orifice (Urinogenital aperture)

(b) (i) Differences between vasa efferentia and vasa deferens are as follows:

	Vasa efferentia	**Vas deferens**
(i)	They arise from the rete testis.	They arise from the cauda epididymis.
(ii)	They vary from 15 to 20 in number.	They are only 2 in number.
(iii)	Vasa efferentia are fine.	Vasa deferentia are thick.
(iv)	Their lining bears many ciliated cells.	Their lining has many stereocilia.
(v)	It carries spermatozoa from the rete testis to the epididymis.	It carries spermatozoa from cauda epididymis to the ejaculatory duct.

(ii) Differences between spermatogenesis and spermiogenesis are as follows:

	Spermatogenesis	Spermiogenesis
(i)	It is the process of formation of haploid spermatozoa from germinal cells.	It is the process of differentiation of spermatozoan from a spermatid.
(ii)	It involves conversion of a diploid structure into haploid structures.	It changes a haploid structure into another haploid structure.
(iii)	There is growth and divisions During spermatogenesis.	There is reconstruction during spermiogenesis. Divisions and growth are absent.
(iv)	No organelle is lost.	Golgi bodies are lost during spermiogenesis.
(v)	A spermatogonium forms four spermatozoa.	Here a spermatid forms a single spermatozoan.
(vi)	It consists of multiplication phase, spermatocytogenesis, maturation phase and	It consists of only differentiation phase.

Note:

- Vasa efferentia and vas deferens are male sex accessory ducts.

37. (a) In spermatogenesis, the growth phase is very short. The spermatogonium actively grows into a larger primary spermatocyte by obtaining nourishment from the nursing cells.

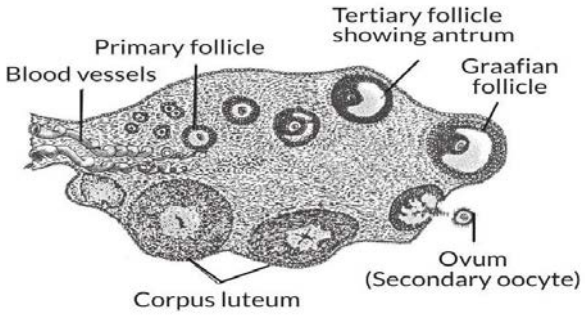
Note:

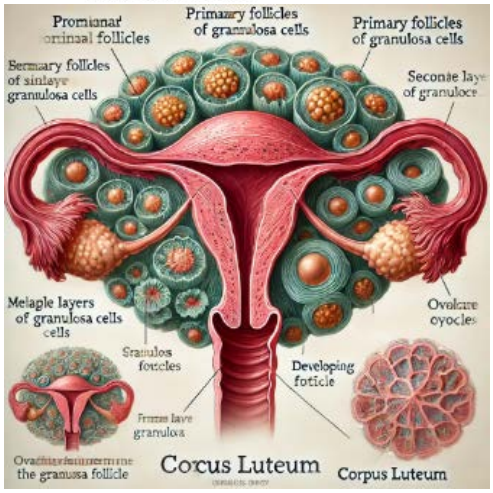
- Vasa efferentia and vas deferens are male sex accessory ducts.

37. (a) In spermatogenesis, the growth phase is very short. The spermatogonium actively grows into a larger primary spermatocyte by obtaining nourishment from the nursing cells.

In oogenesis, the growth phase is very long. It may extend over many years. The oogonium grows into a large primary oocyte. It then gets surrounded by a layer of granulosa cells to form primary follicle. A large number of these follicles degenerate during the period from birth to puberty. So, at puberty only $60{,}000 - 80{,}000$ primary follicles are left in each ovary.

(b) Diagrammatic sectional view of human ovary showing different follicular stages, ovum and corpus luteum is as follows :





(b) **Follicular Phase (Days 1-14)**:

- **Ovarian Hormones**: Estrogen levels gradually increase as the follicles in the ovary mature.
- **Pituitary Hormones**: Follicle-stimulating hormone (FSH) levels rise to stimulate follicle growth. Luteinizing hormone (LH) remains relatively low until it spikes just before ovulation.

Ovulation (Around Day 14):

- **Ovarian Hormones**: Estrogen levels peak, triggering a surge in LH.
- **Pituitary Hormones**: LH surges dramatically, causing the release of the mature egg from the follicle. FSH also rises but to a lesser extent.

Luteal Phase (Days 15-28):

•Ovarian Hormones: Progesterone levels rise, produced by the corpus luteum, and estrogen levels remain elevated.

•Pituitary Hormones: Both FSH and LH levels drop after the ovulatory surge.

- **Menstruation (Days 1-5 of the new cycle)**:
  - **Ovarian Hormones**: Both estrogen and progesterone levels fall, leading to the shedding of the uterine lining.
  - **Pituitary Hormones**: FSH levels begin to rise again to start the next cycle.

39. (a): In ovulatory phase, both LH and FSH hormones are active and attain a peak level.
40. (c): FSH (follicle stimulating hormone) secreted by the anterior lobe of the pituitary gland which stimulates follicular development as well as secretion of estrogens by the growing follicles.

41. (a) The average age of the women at the onset of menopause is 50 years.
(b) According to the given graph, maximum primordial follicles are present in premenopausal women of age around 5-10 years.

42. High concentration of LH cause rupturing of Graafian follicle and thereby the release of ovum. This is called ovulation.

43. X- In woman X thickness of uterine wall increases after mid of menstrual cycle, Reason- due to fertilization of egg/pregnancy/conceived • Y- In woman Y thickness of uterine wall decreases after mid of menstrual cycle, Reason- egg has not been fertilized/leading to the breakdown of lining of the uterus/menstrual flow/ bleeding. The graph depicts the variation in the thickness of the uterine wall over a period of 30 days, which corresponds to the menstrual cycle.

Woman 'X' shows a gradual increase in wall thickness, suggesting a normal menstrual cycle with phases of proliferation and secretion.
Woman 'Y' shows a different pattern, possibly indicating a disrupted or irregular menstrual cycle

44. The menstrual phase is followed by proliferative phase (Days 5-14). Proliferative phase consists of growth of endometrium of uterus, fallopian tube and vagina. In ovary, a Graafian follicle grows, matures and secretes estrogen during this phase. The endometrium grows thicker and becomes more vascularised and glandular. Change in the levels of pituitary and ovarian hormones bring about these changes in the ovary and uterus.

The levels of LH and FSH increase gradually during this phase and stimulates follicular development as well as secretion of estrogens by the growing follicles.

45. Menstrual cycle is regulated by certain hormones, some of which are secreted by the pituitary gland. The pituitary gland is stimulated by releasing factors produced in hypothalamus. The hormones produced by pituitary gland influence the ovaries, which in turn affect the uterus. Anterior pituitary gland secretes two hormones FSH and LH. FSH stimulates maturation of follicle and stimulate it to secrete estrogens. Rapid secretion of LH (LH surge) induces rupturing of Graafian follicle, thereby leading to release of ovum (ovulation).

Ovary secretes two hormones: estrogen and progesterone. Estrogen stimulates follicular development and proliferation of the endometrium of the uterine wall. Progesterone produced by corpus luteum helps to maintain endometrium which is required for implantation of the fertilised ovum and other events of pregnancy.

46. (a) During 13-15 days, FSH stimulates the ovarian follicle to secrete estrogens that further stimulate the proliferation of the endometrium of the uterine wall. On 14^{th} day, LH surge causes ovulation.

(b) From 16 to 23 days, the remaining cells of the ovarian follicles are stimulated by the LH to develop corpus luteum. The corpus luteum secretes progesterone which is required for the maintenance of endometrium. In the absence of fertilisation, corpus luteum degenerates causing disintegration of endometrium leading to menstruation that takes place for 3-5 days.

(c) During 24 to 29 days (luteal phase of 15 to 28 days), the luteinising hormone (LH) is secreted by the anterior lobe of the pituitary gland. LH causes ovulation. The remaining cell of the ovarian follicles are stimulated by the LH to develop corpus luteum. The corpus luteum secretes large amount of progesterone. Progesterone stimulates the uterine glands to produce increased amount of watery mucus. During the secretory phase, there is also similar increase in the secretion of watery mucus by the vaginal glands and by the glands of the fallopian tubes. Progesterone is also essential for maintenance of the endometrium which is necessary for implantation of the fertilised ovum and other events of pregnancy. In the absence of fertilisation, the corpus luteum degenerates. This causes disintegration of the endometrium leading to menstruation marking a new cycle.

47. (a) From 8-12 days (follicular phase), the level of gonadotropins (LH and FSH) increase gradually and stimulate follicular development as well as secretion of estrogens by growing follicles.
(b) Refer to above answer .
(c) Refer to above answer.

48. (a) In human females, menstruation is repeated at an average interval of about 28/29 days, and the cycle of events starting from one menstruation till the next one is called the menstrual cycle.

Menstrual cycle in a human female consists of menstrual phase, proliferative phase (follicular phase), ovulatory phase and secretory phase (luteal phase).

(i) The cycle starts with the menstrual phase, when menstrual flow occurs and it lasts for 3-5 days. The menstrual flow results due to breakdown of endometrial lining of the uterus and its blood vessels which forms liquid that comes out through vagina. Menstruation only occurs if the released ovum is not fertilised.

(ii) The menstrual phase is followed by proliferative phase (Days 5-14). Proliferative phase consists of growth of endometrium of uterus, fallopian tube and vagina. In ovary, a Graafian follicle grows, matures and secretes estrogen during this phase. The endometrium grows thicker and becomes more vascularised and glandular. Change in the levels of pituitary and ovarian hormones bring about these changes in the ovary and uterus. The levels of LH and FSH increase gradually during this phase and stimulates follicular development as well as secretion of estrogens by the growing follicles.

(iii) In ovulatory phase, both LH and FSH attain a peak level in the middle of cycle (about 14^{th} day). Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge induces rupture of Graafian follicle and thereby the release of ovum (ovulation).

(iv) After ovulation and in response to luteinising hormone, the portion of the Graafian follicle that remains in the ovary enlarges and is transformed into a corpus luteum containing yellow substance (called lutein) and the luteal phase begins. The corpus luteum secretes large amount of progesterone which is essential for maintenance of endometrium. Such an endometrium is necessary for implantation of the fertilised ovum and other events of pregnancy. In the absence of fertilisation, the corpus luteum degenerates. This causes disintegration of the endometrium leading to menstruation, marking a new cycle.

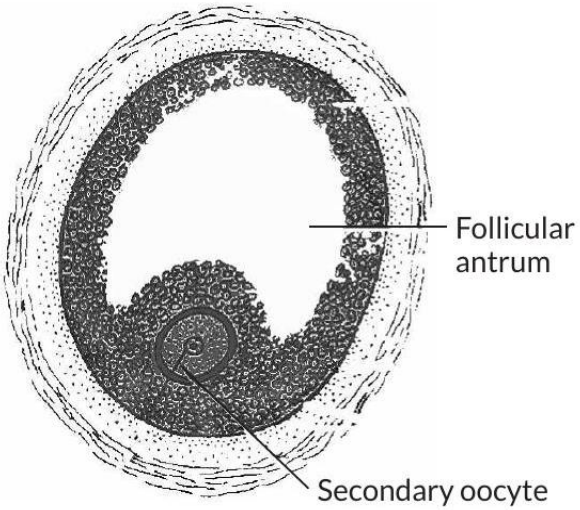
(b) Scientific understanding of menstrual cycle of human females helps as a contraceptive measure because ovulation occurs at about the 14^{th} day of the menstruation. Hence, avoiding or abstaining from coitus from days 10 to 17 of the cycle reduces the chances of fertilisation as ovum survives for about 1-2 days and sperms survive for about 3 days. So, temporary avoidance of coitus during this phase will help as natural method of birth control.

49. (a) In a 28-day menstrual cycle, the menses takes place on days $3 - 5$. The production of LH from the anterior lobe of the pituitary gland is considerably reduced. The withdrawal of this hormone causes degeneration of the corpus luteum and, therefore, progesterone production from the ovary is reduced. Production of estrogens from the ovary is also reduced in this phase. The endometrium of the uterus breaks down and menstruation begins. The cells of endometrium secretions, blood and the unfertilised ovum constitute the menstrual flow.

(b) During follicular phase, follicle stimulating hormone (FSH) stimulates the ovarian follicle to secrete estrogens, which in turn stimulate the proliferation of the endometrium of the uterine wall. As a result, endometrium becomes thicker by rapid cell multiplication and is accompanied by an increase of uterine gland and blood vessels. Hence, this phase is also referred as proliferative phase.

(c) At the time of ovulation, rapid secretion of LH induces rupturing of Graafian follicle, thereby releasing ovum. After ovulation has taken place, LH stimulates cells of ovarian follicle to develop corpus luteum. Corpus luteum secretes large amount of progesterone.

(d) The structure of a mature Graafian follicle is as follows:



50. Menstrual cycle in a human female consists of menstrual phase, proliferative phase (follicular phase), ovulatory phase and secretory phase (luteal phase). Days 1-5 of the cycle are known as the menstrual phase. During this phase, menstruation occurs. At the beginning of this stage, levels of progesterone and estrogen have dropped dramatically because of the degeneration of the last cycle's corpus luteum.

This triggers the shedding of endometrium. The detached portion of the endometrium as well as blood will pass through the vagina as the menstrual flow. Days 5-14 are known as the proliferative phase. Proliferative phase consists of growth of endometrium of uterus, fallopian tube and vagina. In ovary, a Graafian follicle grows, matures and secretes estrogen during this phase. The endometrium grows thicker and becomes more vascularised and glandular. Changes in the level of pituitary and ovarian hormones bring about these changes in the ovary and uterus. The level of LH and FSH increase gradually during the follicular phase and stimulate follicular development as well as secretion of estrogens by the growing follicles. In ovulatory phase, both LH and FSH attain a peak level in the middle of cycle (about 14^{th} day). Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge induces rupture of Graafian follicle and thereby the release of ovum (ovulation).
Days 15-28 are known as luteal phase or secretory phase. After ovulation and in response to luteinising hormone, the portion of the Graafian follicle that remains in the ovary enlarges and is transformed into a corpus luteum containing yellow substance (called lutein) and the luteal phase begins. The corpus luteum secretes large amounts of progesterone which is essential for maintenance of endometrium. Such an endometrium is necessary for implantation of the fertilised ovum and other events of pregnancy. In the absence of fertilisation, the corpus luteum degenerates. This causes disintegration of the endometrium leading to menstruation, marking a new cycle.

51. (i) Follicular Phase/Proliferative Phase:

- **Ovarian Events:** During this phase, several ovarian follicles begin to mature under the influence of follicle-stimulating hormone (FSH) secreted by the pituitary gland. One dominant follicle continues to develop, while others degenerate.
- **Uterine Events:** The endometrium (lining of the uterus) thickens in response to estrogen produced by the developing follicles. This prepares the uterus for implantation of a fertilized egg.
- **Hormones Involved:** FSH stimulates follicle development, leading to the production of estrogen by the developing follicles.

(ii) Luteal Phase/Secretory Phase:

- **Ovarian Events:** After ovulation, the ruptured follicle forms the corpus luteum, which secretes progesterone and estrogen.
- **Uterine Events:** Progesterone and estrogen cause further thickening and vascularization of the endometrium, preparing it for implantation.

- **Hormones Involved:** LH (luteinizing hormone) stimulates ovulation and promotes the formation of the corpus luteum, which secretes progesterone and estrogen.

(iii) Menstrual Phase:

- **Ovarian Events:** If fertilization does not occur, the corpus luteum degenerates, causing a drop in progesterone and estrogen levels.
- **Uterine Events:** The loss of hormonal support leads to shedding of the endometrial lining, resulting in menstrual bleeding.
- **Hormones Involved:** Decreased levels of progesterone and estrogen trigger the shedding of the endometrium.

52. (d)

53.

(a)

Hormone	Source Organ
FSH	Pituitary gland
LH	Pituitary gland
Estrogen	ovary / graafian follicle
Progesterone	ovary / corpus luteum

(any two hormones with their relevant source organ)

(b) Luteal phase or Secretory phase of the menstrual cycle, as endometrium is grown and suitable for implantation of an early embryo or blastocyst.

(c) Estrogen, ovary / graafian (mature) follicles - Endometrium of uterus regenerates through proliferation.

OR

(c) If ovum is not fertilized corpus luteum degenerates, progesterone level falls, disintegration of endometrium (and its blood vessels), leading to menstrual flow.

54. During fertilisation, a sperm comes in contact with the zona pellucida layer of ovum which induces changes in the egg membrane that block the entry of additional sperms. So, zona pellucida ensures that only one sperm can fertilise an ovum.

Note:

P Polyspermy-Entry of more than one sperm into oocyte.

Monospermy -Entry of one sperm into oocyte.

55. The motile sperms swim rapidly, pass through the cervix, enter into the uterus and finally reach the junction of the isthmus and ampulla (ampullary-isthmic junction) of the fallopian tube. The ovum released by the ovary is also transported to the ampullary-isthmic junction where fertilisation takes place. During fertilisation, a sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane that block the entry of additional sperms. The secretions of the acrosome help the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. This induces the completion of the meiotic division of the secondary oocyte. The second meiotic division is also unequal and results in the formation of a second polar body and haploid ovum (ootid). Soon the haploid nucleus of the sperms and that of the ovum fuse together to form a diploid zygote.

56. Fimbriae, infundibulum, ampulla and isthmus are the main parts of oviduct, through which ovum travels till it meets the sperm for fertilisation. Finally it reach the ampullary-isthmic junction of oviduct where fertilisation occurs.

57. (a) Morula is shown in figure A and blastocyst is shown in the figure B. ' ' is inner cell mass and ' D ' is trophoblast.

(b) Inner cell mass (C) forms the fetus. The cells of trophoblast (D) helps to provide nutrition to the embryo. The cells of trophoblast later form the extra embryonic membranes.

58. The events of fertilisation in human female are:

(i) Acrosomal reaction: After ovulation, the secondary Oocyte reaches the fallopian tube. The capacitated sperm releases hydrolytic enzymes (sperm lysins) present in the acrosome, when it comes in contact with surface of egg covering. Important sperm lysins are (i) hyaluronidase that acts on the ground substances of follicle cells, (ii) corona penetrating enzyme that dissolves corona radiata and (iii) zona lysine or acrosin that helps to digest the zona pellucida. Due to acrosomal reaction, plasma membrane of sperm fuses with that of secondary oocyte and depolarisation of oocyte membrane occurs.

(ii) Cortical reaction : Immediately after the fusion of sperm and egg plasma membranes, the egg shows a cortical reaction to further check the entry of more sperms. In this reaction, the cortical granules present beneath the ovum's plasma membrane fuse with the same and release their contents (enzymes) between it and zona pellucida.

These enzymes harden the zona pellucida, which now functions as the sure block to polyspermy.
(iii) Sperm entry: The egg extends around the entering sperm, finger-like processes, called microvilli, which constitute a fertilisation cone. The latter take the entire sperm into the egg. The distal centriole of the sperm divides and forms two centrioles to generate the mitotic spindle for cell division.
(iv) Karyogamy: The sperm entry stimulates the egg (secondary oocyte) to resume and complete the suspended meiosis - II. This produces a haploid mature ovum and a
second polar body. The head of sperm separates from the middle piece and tail to become male pronucleus and nucleus of ovum is called female pronucleus. The second polar body and sperm tail degenerate. Mixing up of the chromosomes of a spermatozoon and an ovum is called karyogamy or amphimixis. This completes the act of fertilisation. The fertilised ovum is now a diploid cell having 23 pairs of chromosomes, and is termed zygote.
The events of implantation are discussed as follows: Implantation is the attachment of blastocyst to the uterine wall. It occurs after 7 days of fertilisation. As zygote moves towards the uterus, it undergoes series of mitotic divisions known as cleavage and forms 2,4,8,16 daughter cells called blastomeres. The embryo with 8 blastomeres is called morula. The morula transforms into blastocyst. In a blastocyst, the blastomeres are arranged into an outer layer called trophoblast and an inner group of cells called the inner cell mass. The trophoblast then gets attached to the endometrium and the inner cell mass gets differentiated as the embryo. After attachment the uterine cells divide rapidly and cover the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus. This whole phenomenon is called implantation and it leads to pregnancy.

59. Blastocyst gets implanted in the uterus.
Implantation is the attachment of blastocyst to the uterine wall. It occurs after 7 days of fertilisation. As zygote moves towards the uterus, it undergoes series of mitotic divisions known as cleavage and forms 2,4,8,16 daughter cells called blastomeres. The embryo with 8 blastomeres is called morula. The morula transforms into blastocyst. In a blastocyst, the blastomeres are arranged into an outer layer called trophoblast and an inner group of cells called the inner cell mass. The trophoblast then gets attached to the endometrium and the inner cell mass gets differentiated as the embryo. After attachment the uterine cells divide rapidly and cover the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus. This whole phenomenon is called implantation and it leads to pregnancy.

60. (i) : a - Cells of corona radiata
b - Perivitelline space
c - Ovum nucleus
(ii) The meiotic division is completed before fertilisation in fallopian tube. The entry of sperm stimulates the egg (secondary oocyte) to resume and complete the suspended meiosis - II. This produces a haploid mature ovum and a second polar body. (iii) Binding of the sperm to the zona pellucida of secondary oocyte induces depolarisation of the oocyte plasma membrane and prevents polyspermy i.e., entry of more than one sperm into the oocyte.

61. (i) Embryonic stage ' e ' is morula while ' g ' is blastocyst. Morula is a mulberry like solid mass of 8-16 cells called blastomeres formed by cleavage of zygote while the blastocyst is a hollow sphere of 64 cells formed by the rearrangement of blastomeres of morula. It has a cavity called blastocoel and an inner cell mass within. It also has an outer envelope of cells called the trophoblast.
(ii) Refer to answer 53.

62. Fertilisation occurs in the ampullary-isthmic junction of the fallopian tube of female. The events of fertilisation in human female are:
(i) Acrosomal reaction: After ovulation, the secondary oocyte reaches the fallopian tube. The capacitated sperm releases hydrolytic enzymes (sperm lysins) present in the acrosome, when it comes in contact with surface of egg covering. Important sperm lysins are (i) hyaluronidase that acts on the ground substances of follicle cells, (ii) corona penetrating enzyme that dissolves corona radiata and (iii) zona lysine or acrosin that helps to digest the zona pellucida. Due to acrosomal reaction, plasma membrane of sperm fuses with that of secondary oocyte and depolarisation of oocyte membrane occurs.
(ii) Cortical reaction: Immediately after the fusion of sperm and egg plasma membranes, the egg shows a cortical reaction to further check the entry of more sperms. In this reaction, the cortical granules present beneath the ovum's plasma membrane fuse with the same and release their contents (enzymes) between it and zona pellucida. These enzymes harden the zona pellucida, which now functions as the sure block to polyspermy.
(iii) Sperm entry: The egg extends around the entering sperm, finger-like processes, called microvilli, which constitute a fertilisation cone. The latter take the entire sperm into the egg. The distal centriole of the sperm divides and forms two centrioles to generate the mitotic spindle for cell division.

(iv) Karyogamy: The sperm entry stimulates the egg (secondary oocyte) to resume and complete the suspended meiosis - II. This produces a haploid mature ovum and a second polar body. The head of sperm separates from the middle piece and tail to become male pronucleus and nucleus of ovum is called female pronucleus. The second polar body and sperm tail degenerate. Mixing up of the chromosomes of a spermatozoon and an ovum is called karyogamy or amphimixis. This completes the act of fertilisation. The fertilised ovum is now a diploid cell having 23 pairs of chromosomes, and is termed zygote.

63. (a) The motile sperms swim rapidly, pass through the cervix, enter into the uterus and finally reach the junction of the isthmus and ampulla (ampullary-isthmic junction) of the fallopian tube. The ovum released by the ovary is also transported to the ampullary-isthmic junction where fertilisation takes place. During fertilisation, a
sperm comes in contact with the zona pellucida layer of the ovum and induces changes in the membrane that block the entry of additional sperms. The secretions of the acrosome help the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. This induces the completion of the meiotic division of the secondary oocyte. The second meiotic division is also unequal and results in the formation of a second polar body and haploid ovum (ootid). Soon the haploid nucleus of the sperms and that of the ovum fuse together to form a diploid zygote.

(b) Blastocyst gets implanted in human female. In a blastocyst, the blastomeres are arranged into an outer layer called trophoblast and an inner group of cells called the inner cell mass. The trophoblast then gets attached to the endometrium and the inner cell mass gets differentiated as the embryo. After attachment the uterine cells divide rapidly and cover the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus. This whole phenomenon is called implantation and it leads to pregnancy.

64. (a) Sperm ' A ' would reach the ovum earlier than both ' B ' and ' C '.

(b) In the given diagram, ' D ' is corona radiata that is formed of radially elongated follicular cells. ' ' is zona pellucida that is present outside the perivitelline space. The function of the zona pellucida is to prevent the implantation of the blastocyst at an abnormal site. It does not expose the sticky and phagocytic cells of the trophoblast till the blastocyst reaches the proper implantation site. As the blastocyst is formed, zona pellucida becomes thinner and finally disappears.

(c) The sperms in the female genital tract are made capable of fertilising the egg by secretions of the female genital tract. These secretions remove coating substances deposited on the surface of sperm, mainly on acrosome and exposes its receptor sites. The phenomenon of sperm activation in mammals is known as capacitation. The capacitated sperms undergo acrosomal reaction and release various chemicals contained in the acrosome. These chemicals are collectively called sperm lysins. Important sperm lysins are: hyaluronidase, corona penetrating enzymes and zona lysine or acrosin.

Due to acrosomal reaction, plasma membrane of the sperm fuses with the plasma membrane of the secondary oocyte so that the sperm contents enter the oocyte.

The changes occurring in the ovum are as follows:

(i) During fertilisation, binding of the sperm to the secondary oocyte induces depolarisation of the oocyte plasma membrane. Depolarisation prevents polyspermy. Thus, it ensures that only one sperm can fertilise an ovum. (ii) The cortical granules present beneath the plasma membrane of the secondary oocyte fuse with the plasma membrane and release their contents including cortical enzymes.

(iii) The secondary oocyte forms a projection termed fertilisation cone which receives the sperm.

(iv) Sperm entry stimulates the metabolism in the fertilised ovum (zygote). As a result, the rates of cellular respiration and protein synthesis increase greatly.

(d) It takes place in the ampullary isthmic junction of the fallopian tube.

Note:

- Cortical enzymes between plasma membrane and zona pellucida harden the zona pellucida to prevent polyspermy.
-

65. Fertilisation occurs in ampullary-isthmic junction of fallopian tube.

The events of implantation are discussed as follows: Implantation is the attachment of blastocyst to the uterine wall. It occurs after 7 days of fertilisation. As zygote moves towards the uterus, it undergoes series of mitotic divisions known as cleavage and forms 2,4,8,16 daughter cells called blastomeres. The embryo with 8 blastomeres is called morula. The morula transforms into blastocyst. In a blastocyst, the blastomeres are arranged into an outer layer called trophoblast and an inner group of cells called the inner cell mass. The trophoblast then gets attached to the endometrium and the inner cell mass gets differentiated as the embryo. After attachment the uterine cells divide rapidly and cover the blastocyst. As a result, the blastocyst becomes embedded in the endometrium of the uterus.

This whole phenomenon is called implantation and it leads to pregnancy.

66. (d):During embryonic development, human fetus develops limbs and digits by the end of second month of pregnancy, i.e., 60 days.

67. (d): The chorionic villi and uterine tissue becomes interdigitated with each other to form a structural and functional unit between developing embryo and maternal body called placenta. Inner cell mass of the blastocyst differentiates into ectoderm, endoderm and mesoderm immediately after implantation.

68. (B) Human Chorionic Gonadotropin (hCG)

69. Human chorionic gonadotrophin (hCG), human placental lactogen (hPL) and relaxin are produced in women only during the pregnancy. There would be a rapid increase in estrogen levels during the first trimester. It plays major role in the milk duct development that enlarge the breasts during second trimester. Progesterone level remain high throughout the pregnancy.

70. The placenta acts as an endocrine gland and secretes hormones : human chorionic gonadotropin (hCG), human chorionic somatomammotropin (hCS), progesterone, estrogen, relaxin, chorionic thyrotropin and chorionic corticotropin.

The hCG stimulates and maintains the corpus luteum to secrete progesterone until the end of pregnancy. The hCS stimulates the growth of the mammary glands during
pregnancy. Relaxin facilitates parturition (act of birth) by softening the connective tissues of the pubic symphysis. The level of hormones like estrogen, progesterone, etc. are increased in maternal blood during pregnancy. Increased production of these hormones is necessary for supporting the fetal growth, metabolic changes in mother and maintenance of pregnancy.

71. After implantation, finger-like projections appear on the trophoblast called chorionic villi which are surrounded by the uterine tissue and maternal blood. The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (fetus) and maternal body called placenta, which facilitates the supply of oxygen and nutrients to the embryo and also removal of carbon dioxide and excretory waste materials produced by the embryo.

Placenta also acts as an endocrine tissue and produces several hormones essential for supporting the fetal growth, metabolic changes in the mother and maintenance of pregnancy.

72. (a) Refer to above answer

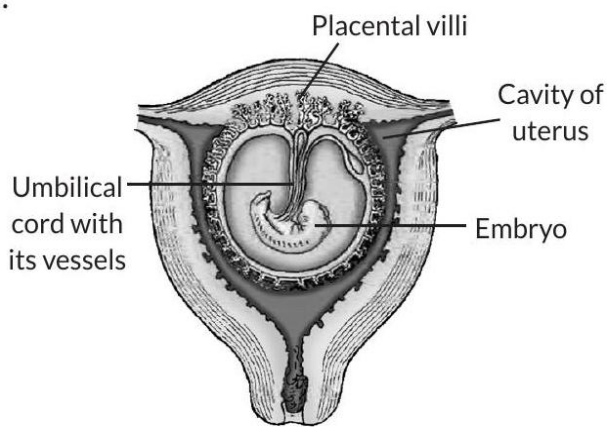
(b) Estrogen and progesterone are two hormones, secreted by placenta and they are also present in nonpregnant woman.

Note:

- Estrogen - Proliferation of endometrium.
- FSH - Maintenance of endometrium.

73. (i) The placenta begins to develop after implantation of a blastocyst which occurs in the maternal endometrium. The blastocysts have two different cell types; they have outer trophoblast cells and inner cell mass. These trophoblast cells develop to form the placenta, while the inner cell mass forms the fetus and fetal membrane. The placenta is formed by 18 - 20 weeks and continues to grow throughout the pregnancy. It has a length of about $22\ \text{cm}$ and a width of about $2.5\ \text{cm}$. By the 12 weeks, the placenta is formed and ready to help the fetus with the nourishment. It allows in the uptake of nutrients, eliminates waste, aids in thermoregulation and gases exchange. Antibodies like IgG can pass through the human placenta and later it protects the fetus in the uterus. Placenta also performs the endocrine function, i.e. they release few hormones which are needed for the growth of sex organs.

(ii) The diagram of human fetus within the uterus is as follows:



74. (a) The sequence of secretion of the given hormones in a pregnant woman is :

$\text{FSH} \rightarrow \text{LH} \rightarrow \text{hCG} \rightarrow$ Relaxin

(b) Sources and functions of hormones are:

Hormone	Source	Function
hCG	Chorionic cells of placenta	Stimulates and maintains the corpus luteum to secrete progesterone.
LH	Anterior lobe of pituitary	Induces ovulation and stimulates corpus luteum to secrete progesterone.
FSH	Anterior lobe of pituitary	Stimulates the growth of ovarian follicles and secretion of estrogen in females.
Relaxin	Ovary	Soften the ligaments that hold the pubic symphysis together for dilation of cervix.

75.(a) Placenta develops after implantation of embryo in the uterus of human female. After implantation, finger-like projections appear on the trophoblast called chorionic villi which are surrounded by the uterine tissue and maternal blood. The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (fetus) and maternal body called placenta, which facilitates the supply of oxygen and nutrients to the embryo and also removal of carbon dioxide and excretory waste materials produced by the embryo.

Placenta also acts as an endocrine tissue and produces several hormones essential for supporting the fetal growth, metabolic changes in the mother and maintenance of pregnancy.

(b) An umbilical cord connects placenta to the embryo.

(c) Refer to answer 63

76. (d):Myometrium of uterus exhibits strong contraction during the delivery of baby.

Note:

- Myometrium is middle thick layer of uterus consisting of smooth muscle.

77. The signals for parturition originate from the fully developed fetus and the placenta induce mild uterine contractions called fetal ejection reflex.

78. Yes, I agree that all young mothers must breastfeed their newborn babies to provide best nourishment to them. Human milk consists of fat, casein (milk protein), lactose (milk sugar), mineral salts (sodium, calcium, potassium, phosphorus, etc). and vitamins that are necessary for development of the child. Mammary glands start producing milk at the end of pregnancy. The milk produced by the mammary glands of mother during initial days after child birth, for 2 to 3 days is called colostrum. It is rich in proteins (lactalbumin and lactoprotein) and various other nutrients. It also contains certain antibodies (IgA), which provide passive immunity to the baby. This milk helps in developing resistance to disease for newborn babies. It helps the baby to fight from viruses and bacteria.

79. After birth, the breast's first released milk is called colostrum for 2 or 3 days. This is a thin, yellowish, fluid, often called foremilk. It contains cells from the alveoli and is rich in protein (lactalbumin and lactoprotein), antibodies ($\lg A$), but low in fat. Breast-feeding during the initial period of infant growth is recommended by doctors for bringing up a healthy baby.

80. The act of expelling the full term young one from the mother's uterus at the end of gestation period is called parturition. Process of parturition is induced by both nervous system and hormones secreted by the endocrine glands of the mother. The signals for child birth (parturition) originate from the fully matured fetus and placenta which induce mild uterine contractions called fetal ejection reflex. This causes quick release of oxytocin from the maternal pituitary gland.

Oxytocin acts on the uterine muscles and causes stronger uterine contractions which in turn further stimulates the secretion of oxytocin. The stimulatory reflex between the uterine contraction and oxytocin secretion continues resulting in stronger and stronger contractions. This leads to expulsion of the baby from the uterus through the birth canal.

Note:

Relaxin increases the flexibility of pubic symphysis and dilates uterine cervix during labour pains

81. **IUI (Intrauterine Insemination):**

- **Definition:** IUI involves placing prepared sperm directly into the uterus around the time of ovulation to facilitate fertilization.
- **Process:** Sperm is collected, processed in the lab, and then inserted into the uterus via a catheter.
- **Indications:** Used in cases of male infertility, unexplained infertility, or when donor sperm is used.
- **Success Rate:** Success depends on various factors but is generally lower compared to IVF.

IVF (In Vitro Fertilization):

- **Definition:** IVF involves fertilizing an egg with sperm outside the body in a laboratory dish ("in vitro") and then implanting the embryo into the uterus.
- **Process:** Ovarian stimulation is followed by egg retrieval, fertilization in the lab, embryo culture, and finally embryo transfer.
- **Indications:** Used for various infertility issues such as blocked fallopian tubes, endometriosis, male infertility, etc.
- **Success Rate:** Higher success rates compared to IUI, especially in cases where there are severe infertility issues.

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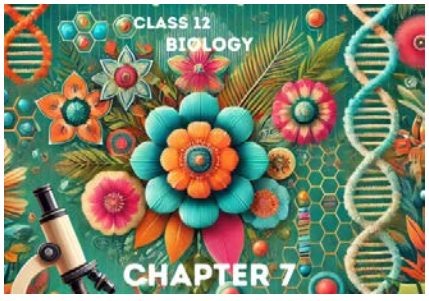

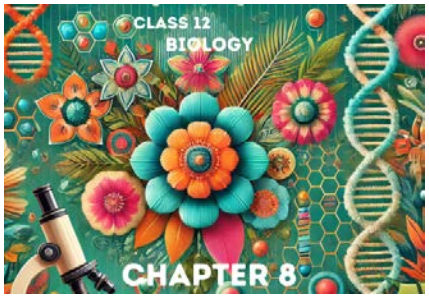

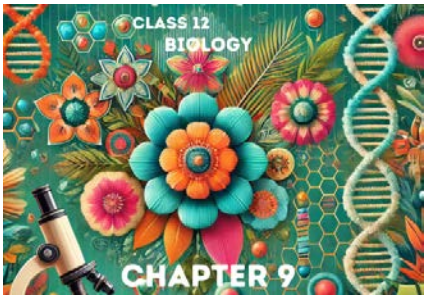

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